NATO Evaluating ALIS - Acquisition Logistics Information System Technology Demonstrator

Logistics Software Demonstrator Based On Rapid Acquisition Development

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Editor's Note: For a complete list of acronyms and abbreviations appearing in the text and figures of this article, refer to p. 12.

As the North Atlantic Treaty Organization (NATO) enters the 21st century, a large amount of information interchange is increasingly required to support NATO's trans-Atlantic acquisition logistics activities. In all probability, NATO partners have used very different information systems for a long time, across a very diverse array of defense systems. Now they are faced with the need to establish, update, and exchange digital information in different formats and with different meanings, using expensive and inefficient interfaces.

The NATO Continuous Acquisition and Life Cycle Support (NATO CALS) organization is building a data model based on an "entity relation" format (formalism) within the now well-known NATO CALS Pilot Project, more commonly known as NCPP No. 1. This large collaborative project involves experts from both government and industry. A core model, the NATO CALS Data Model (NCDM) covers three major activities of acquisition logistics: logistics support analysis, technical documentation, and material support.

Ichisar, Lapaque, and Noël have been working five years on the impact of new information technology (IT) as it affects military/industrial logistics, and the logical linkage between systems engineering and life cycle support.

ALIS Demonstrator

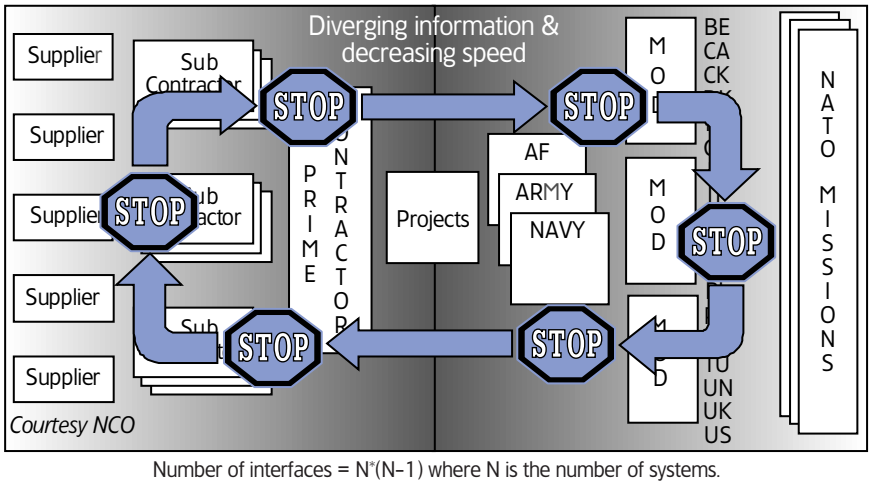
The Acquisition Logistics Information System (ALIS) technology demonstrator enables users to work with an Integrated Weapon System Database, compliant with older legacy systems, to evaluate its benefits to both military and industry. Legacy refers to making an older system compatible with new systems and technologies, and the reverse. For one year, NATO nations — government and industry — will have the opportunity to conduct their own tests and make their own judgments. The ALIS demonstrator is being evaluated under a joint contract involving GIAT Industries of France and ISS Inc., a U.S. firm.

NATO's defense information systems' remodeling is similar to a bottom-up approach, based on operational needs from beginning to end. Remodeling is a major ongoing collaborative program, providing both military and industrial requirements for reconfigurable forces systems and agile enterprise, and vice versa. NATO CALS projects are the current result of a joint U.S./European initiative to create a CALS Organization within NATO capable of implementing the following strategies/initiatives:

- Make international cooperation easier and more flexible (agile).
- Stop and reverse a cost spiral that might come, not only from technology, but also from management.
- Re-establish orderly and appropriate methods within the defense industry, acquisition, and procurement to create a seamless process.

The NATO CALS Organization launched NCPP No. 1 five years ago, working jointly with the NATO CALS Management Board (NCMB) and NATO

FIGURE 1. **Existing Software Rules Decrease Speed & Reliability**

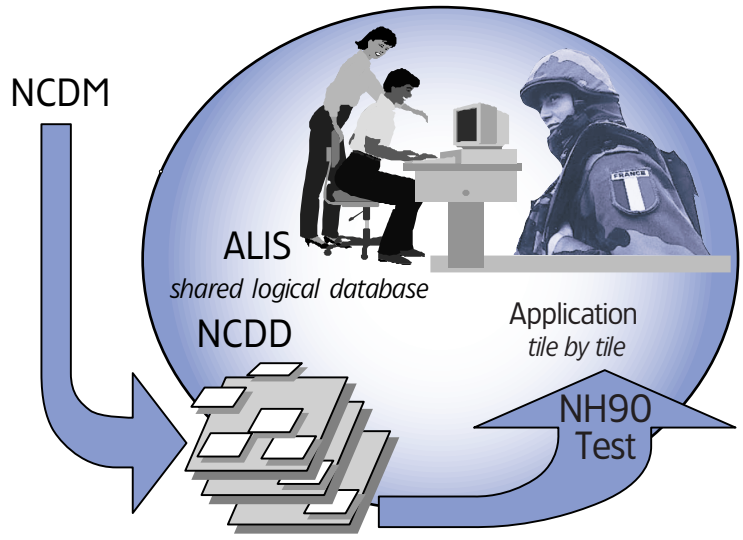


Number of interfaces = N*(N–1) where N is the number of systems.

Acronyms and Abbreviations

AECMA	European Association for Aerospace Industries
AGUSTA	Helicopter Manufacturer (Italian)
ALIS	Acquisition Logistics Information System/ Advanced Logistics Information System
ALDB	Acquisition Logistics Database
ALS	Acquisition Logistics Support
AP	Application Protocol
bdr	battle damage repair
CALS	Continuous Acquisition Life Cycle Support
CALS/CE	CALS Concurrent Engineering
DASA	Daimler Aerospace Systems (German)
DGA	Délégation Générale pour l'Armement (French MoD Armaments Authority)
EC	Electronic Commerce
EDI	Electronic Data Interchange
EDIFACT	Electronic Data Interchange for Administration, Commerce and Transport
FMECA	Failure Modes, Effects, and Criticality Analysis
HLA	High Level Architecture
HW	Hardware
IDE	Integrated Data Environment
IDEF1X	Integrated Computer-aided Manufacturing DEFinition Method 1X
IDEF0	Integrated Computer-aided Manufacturing (ICAM) DEFinition Method 0
ILS	Integrated Logistics Support
Inst	Instruction
ISO	International Standards Organization
IT	Information Technology
IWSDB	Integrated Weapon System Database
JCALS	Joint CALS
LAN	Local Area Network
LMI	Logistics Management Information
LORA	Level of Repair Analysis
LSA	Logistics Support Analysis
MIL-HDBK	Military Handbook
MIL-PRF	Military Performance Specification
MIL-STD	Military Standard
MoD	Ministry of Defence
MRO	Maintenance Repair Overhaul
MS	Maintenance Support
NATO	North Atlantic Treaty Organization
NATO CALS	NATO Continuous Acquisition Life Cycle Support
NCDD	NATO CALS Data Dictionary
NCDM	NATO CALS Data Model
NCMB	NATO CALS Management Board
NCO	NATO CALS Organization
NCPP No. 1	NATO CALS Pilot Project Number 1
NICG	NATO Industry CALS Group
OCCAR	Organisme Conjoint de Coopération en matière d'Armement (Organization for Joint Armament Cooperation)
OLA	Operational Logistics Activity
PDM	Product Data Management
PLCS	Product Life Cycle Standards
PPMG	Pilot Project Management Group
RAD	Rapid Acquisition Development
RCM	Reliability Center Maintainability
Rfb	Request feedback
SGML	Standard Generalized Markup Language
STEP	Standard for the Exchange of Product Model Data
SW	Software
TechDoc	Technical Documentation
TL	Through Life (HLA)
UK-CIC	United Kingdom-CALS International Congress
UK MoD	United Kingdom Ministry of Defence
UN	United Nations
VAN	Vertical Area Networks

FIGURE 2. **From NCDM to ALIS**



Industrial CALS Group (NICG). Elaine Litman of the United States was the NCMB chairwoman; and Henri Martre of France was the NICG chairman. The projects had previously started as a result of three Workshops:

Acquisition Workshop (Programmes d'armement)

Organized by France, the Acquisition Workshop (Programmes d'armement) explained the main ideas on which Acquisition Process Reform and Smart Procurement are still based today – integrated teams and continuous process improvement. The results remain general because systems engineering is more relevant for individual nations than for NATO, which supports the position of the Organisme Conjoint de Coopération en matière d'Armement (OCCAR), or Organization for Joint Armament Cooperation.

Acquisition Logistics Workshop (Logistique des systèmes d'armes)

Organized by the United Kingdom, the Acquisition Logistics Workshop (Logistique des systèmes d'armes) was the platform for launching NCPP No. 1. This forum is focused on the pilot project as well as the ALIS platform, which is one of the tasks of NCPP No. 1, Phase II.

Operational Logistics Workshop (Logistique opérationnelle)

Organized by Germany, the Operational Logistics Workshop (Logistique opérationnelle) is now called the Operational Logistics Activity (OLA). It will bring the elements needed for implementation of the NCDM to the military forces. The United Kingdom Ministry of Defence (UK MoD) gave a decisive and initial push to the NCPP No. 1 by funding the modeling works of Phase I. Germany provided the industrial start-up of Phase II by running the rig-test and closely supporting the launch of the ALIS contract (Task 2.1) by the Délégation Générale pour l'Armement (DGA)/CALS (DGA/CALS).

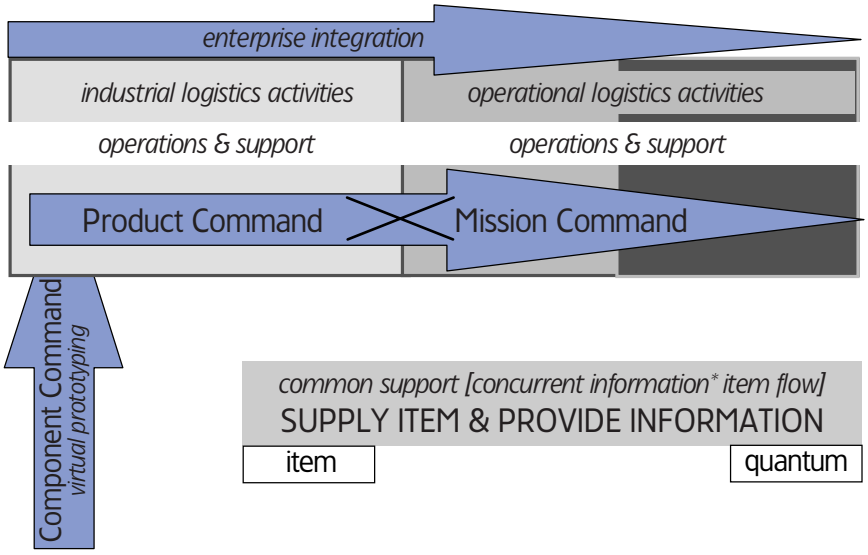
Significant information flows are now expected to run across multiple organizational boundaries throughout the weapons system life cycle. Each of these boundaries creates a fracture line that may slow or even block not only information flows, but also the capabilities to do the expected jobs and missions (Figure 1).

The number of interfaces grows as N*(N-1) when N is the number of systems; for example, with only nine organizations, as many as 72 interfaces would be needed.

Consider what would happen in our business context just on the government side if we had 19 nations, each with three or four Services (if we included the Naval Air Services)! This means that we would have to shift to another paradigm (Figure 2).

Spearheaded by the French Ministry of Defence/Délégation Générale pour l'Armement (MoD/DGA) (i.e., Acquisition, Procurement, and Technology), the ALIS contract is the specific contribution of France to the NATO CALS work during NCPP No. 1, Phase II.

FIGURE 3. **CALS Consistency**

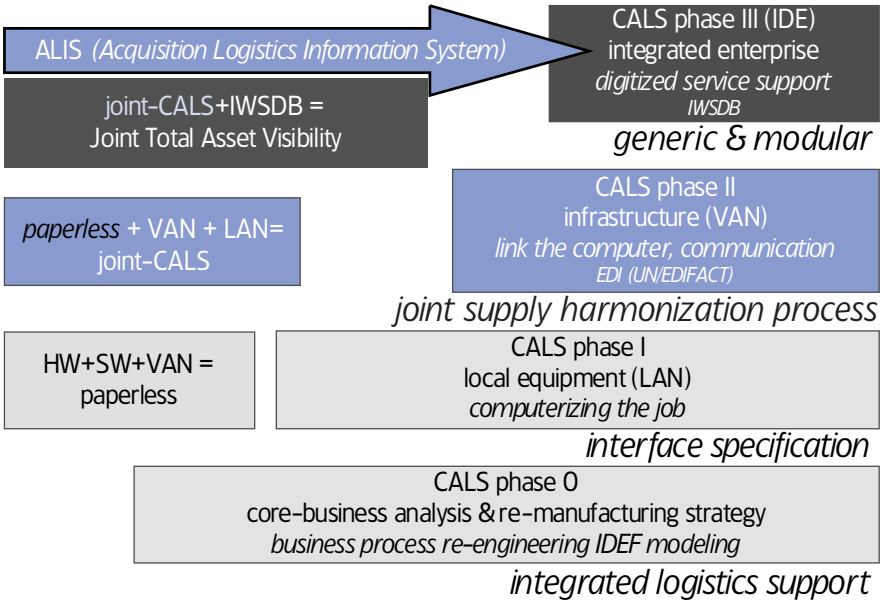


CALS Consistency

Implementing the initiatives and strategies embodied in CALS improves system engineering (Rapid Prototyping) and the logistics organization (Virtual Enterprise) (Figure 3). In addition, CALS promotes concurrent and shared effort from "factory-to-foxhole" in four important areas:

- Reduces Lead Time
- Reduces "Down Time"

FIGURE 4. **CALS Initiative Strategy**



- Reduces Cost
- Improves Quality.

Further, this customer-oriented initiative provides speed and agility between autonomous partners. A continuous process, CALS also brings a "clean room process" to the situation by empowering players with basic skills. As we delve more deeply into CALS, we also receive benefits from information technology (IT). In this area, the ALIS demonstrator is certainly a valued contribution. And as we deal more with IT, we benefit from work already done on an operational and industrial level (providing the next step is taken). But we should not forget that we are still, to a certain extent, in the definition phase. IT requires an incremental approach and strategy (continuous process).

The next step involving the NATO CALS Data Model and the NATO CALS Data Dictionary (after its first fielding application) requires ALIS to go from a proposed model to the advanced model. At this point, it is time to call ALIS the *Advanced* Logistics Information System vs. the *Acquisition* Logistics Information System. To achieve rapid and accurate evolution from proposed model to advanced model requires very strong cooperation between both industry and the military, based on their common interests.

ALIS & CALS

The word CALS is common in the United States, but the concept is not commonly used in Europe. The meaning of the acronym stabilized in 1989-90, and CALS is still defined as continuous life cycle support. From an initial identification of means (computers and software), we understand today that the accent is on the scope itself: a seamless process reducing time and cost on the whole life cycle. The acronym and the concept are now accepted worldwide. Together, they address the general question: What are the most appropriate ways, standards, and models to benefit from continually evolving IT in every branch of business?

CALS Initiative Strategy

We know the start-up of CALS came from benchmarking, which was conducted by DoD's Defense Advanced Research Projects Agency (DARPA), of the best industrial practices, especially from the automotive industry (Figure 4). CALS is no longer viewed as a purely technical approach (the initial CALS Standards, Standard Generalized Markup Language [SGML], and others). Instead, it has become progressively understood as an attempt to introduce a holistic approach to defense and industry, emulating the best worldwide practices — including, for example, those in Japan (material management) and those in Europe (complex systems engineering).

Originally, the question was: "How can the U.S. DoD — both Operational Forces and Acquisition community, or Forces and Procurement — use software to improve the logistics process in a more coordinated manner between the different Service components (Army, Air Force, Navy)?"

The first answers were purely technical: digitize documents, store logistics data from Integrated Logistics Support (ILS) methods [CALS phase 0], and adopt some common data standards, such as

FIGURE 5. **Joint Shared Logical Database**

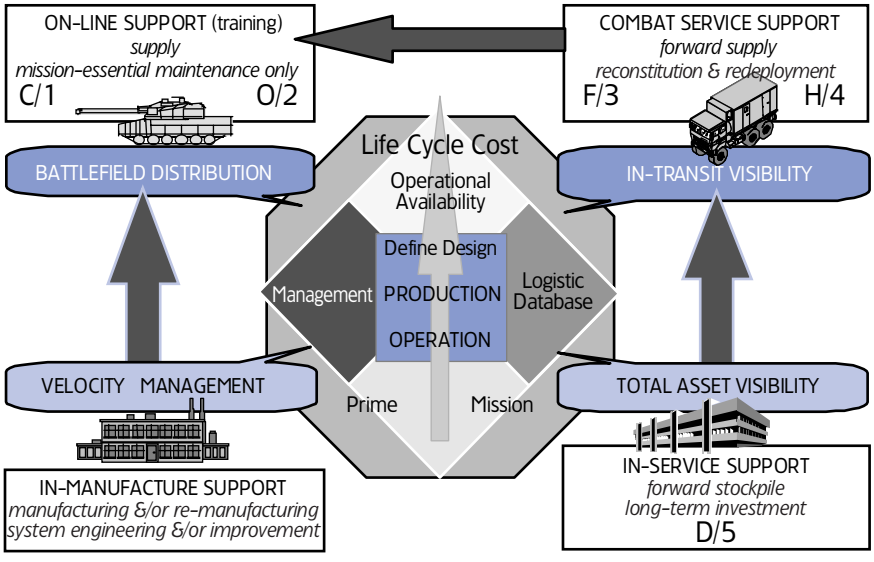
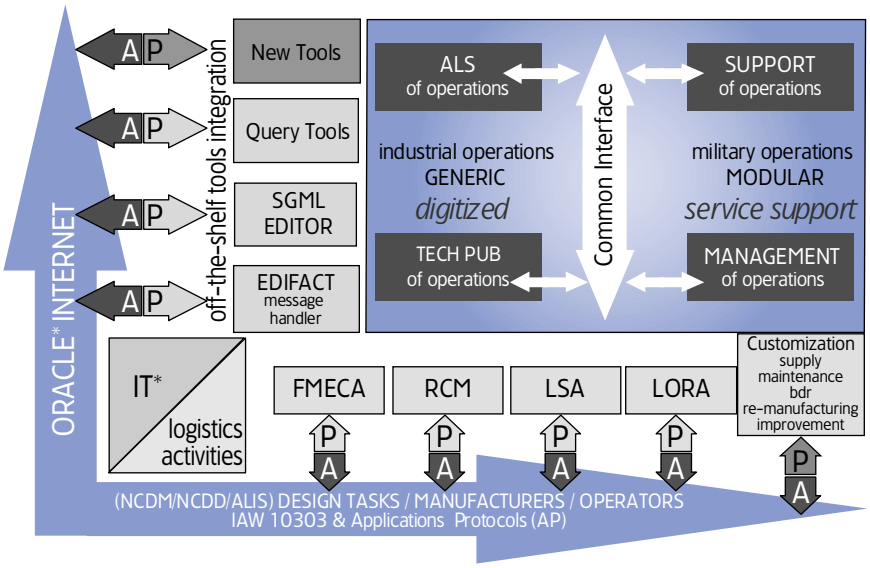


FIGURE 6. **ALIS Structure-ISO 10303 STEP Reliability Center Maintainability**



SGML for execution. This appeared as CALS initiative Phase I: testing and evaluation of the first techniques of digitization.

Then the era of Electronic Data Interchange (EDI) arrived. Europe led the way with EDI for Administration, Commerce and Transport (EDIFACT), with Airbus Industrie and Systeme d'echange technique (SET). The United States followed by implementing electronic commerce with PDES, Inc., using STEP (Standard for Exchange of Product Model Data), which is the International Standards Organization [ISO]-recognized standard. The era of EDI called for new semantic models and definition of features. This could be considered CALS initiative Phase II.

Eventually, the idea that data could be memorized once, manipulated, and then used several times over was seen as evidence of economic savings and added value; thus, CALS addressed not only the logistics process but the whole life cycle — including design and development, production, deployment, and disposal. In addition, it promoted concurrent engineering (CALS/CE) and today's systems engineering.

CALS Phase III marked the maturity of the initiative, enabling the exchange of information to be automated, potentially worldwide, by incorporating the following features/characteristics:

- Virtual Prototyping ("concurrent" information in order to define, design, engineer, and produce an object).
- Integration of information and resources in correlation to the material flow, in order to assemble a product, service, or mission.
- Material Structure or breakdown (e.g., STEP Application Protocol [AP] 204) to link object and product.

Rapid prototyping and incremental processing are the two main characteristics that new IT provides for the improvement of engineering and logistics organizations.

Joint Shared Logical Database

Figure 5 was inspired from a draft by the first U.S. CALS teams 10 years ago. *Joint Total Asset Visibility* defines the concept of a shared, logical database — the key to progress and flexibility. The shared logical database preserves the legacy and gives the necessary freedom of operation: access(es) can be shared between information systems that are naturally different, only on the basis of necessary logical relations within a clear legal status.

The octagon symbolizes the need to generalize weapon-system information sharing on its life cycle, from "factory-to-foxhole." This is almost always done when manufacturing ammunition and running healthcare systems, and is also being applied to the automotive industry.

Battlefield Distribution, U.S. Army; In-transit Visibility, Joint; Velocity Management, U.S. Navy; Total Asset Visibility, U.S. Air Force are the different focuses for the re-engineering of the logistics functions within the CALS initiative. Linked to the basic core functions, they do not have to be re-invented and need to be shared by equivalent organizations in the United States and Europe.

Real Time is the first factor of information reliability. Briefly stated, speed and reliability will create safe and efficient organizations through more reliable information. Today, this is the major way to reduce costs, especially those costs that lack good metrics.

ALIS Structure-ISO 10303 STEP

ALIS is an open (i.e., agile) technology demonstrator (Figure 6). In fact, through the information object module, ALIS allows linkage to any kind of information all along the life cycle, with proper software-version management. It then becomes an experimental platform for logistics re-engineering from "factory-to-foxhole."

This platform is an emulation, built from the existing tools and data under the current standards:

- ISO 10303-STEP.
- Former Military Standard (MIL-STD) 1388 2B (now Military Handbook [MIL-HDBK] 502 and Military Performance Specification [MIL-PRF] 49506).
- European Association for Aerospace Industries (AECMA)/ATA 2000M (EDI-oriented).
- AECMA/ATA 1000D (improvement over the last platform upon which it was running).

Legacy, Life Cycle Support Improvement

This approach allows the crossing of future skills and existing ones (Figure 7).

FIGURE 7. **Legacy, Life Cycle Support Improvement**

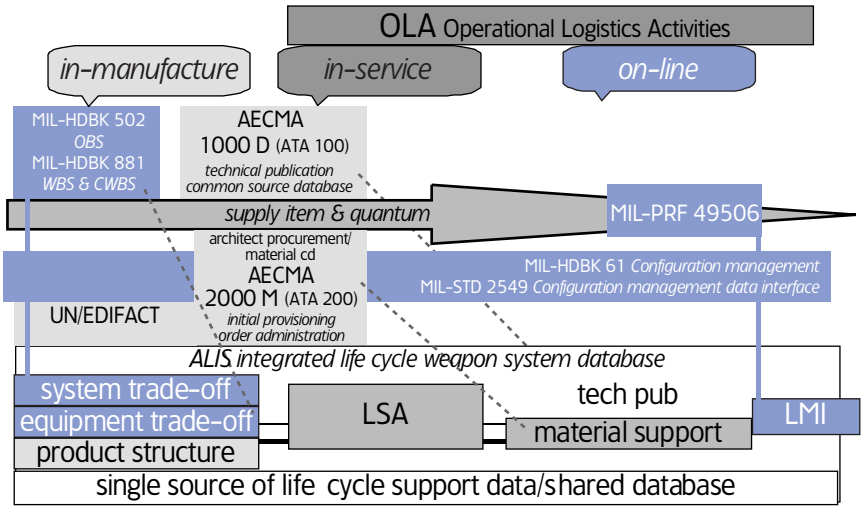
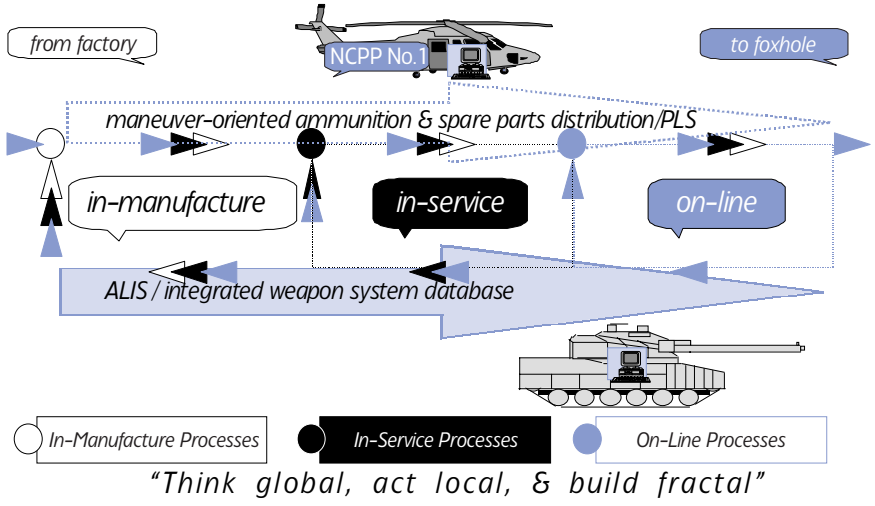


FIGURE 8. **From NCPP No. 1 to Shared Logical Database**



"Think global, act local, & build fractal"

This simple fact demonstrates the necessary agility of the ALIS platform, because it is not possible to modernize logistics without any consideration for legacy systems. ALIS demonstrates and validates the implementation capability of the NCDM V3.0. The requirements came from the NCPP No. 1 Phase I, task 1.6: specifying functional tests needed to demonstrate the validity and efficiency of the model.

The technical analysis needed to answer this requirement was completed within the NCPP No. 1 organization:

The NATO CALS Pilot Project Management Group, NATO CALS Organization (NCO), and NATO Industry CALS Group (NICG) are all part of the NATO CALS Pilot Project (NCPP), or NCCP No. 1., co-chaired by Vincenzo Bunotempo and Admiral Ispettore Vene of Italy, with the participation of international experts. Currently, members are working on several different tasks as part of the technical analysis:

- DASA or Daimler Aerospace Systems (German) for Material Support.
- AGUSTA, a Helicopter Manufacturer (Italian) for logistics support analysis (LSA).
- ECF, or Eurocoter France, a German-French company, for technical documentation (TechDoc).
- A U.S. and French consortium, organized by the French MoD Armaments Authority, or DGA (Délégation Générale pour l'Armement) for the contract.
- Pilot Project Management Group (PPMG) for the request.

Also key to technical analysis of the ALIS platform was the knowledge necessary to make sure ALIS covers weapon systems architecture (long-life systems) as well as advanced software and logistics (including operations and support) from the perspective of both industry and deployed forces. This knowledge is shared by GIAT Industries of France, the European leader in land defence armament; Integrated Support Systems., Inc., of Seneca, S.C., the recognized leader in product support data management software; and Sonovision-Itep of France for

FIGURE 9. **NCPP No. 1 Shared Effort**

SITUATION ISO 10303 (LAW ARMY MATERIEL ACQUISITION PROCESS (AMAP) Std)

Phase 0 : *Research & Exploratory Development*
NCPP No. 1 93-97 & data modeling by UK

mission area analysis
UNITED KINGDOM
DEF STAN 0060 (1˚ Harmonization)

program decision memorandum

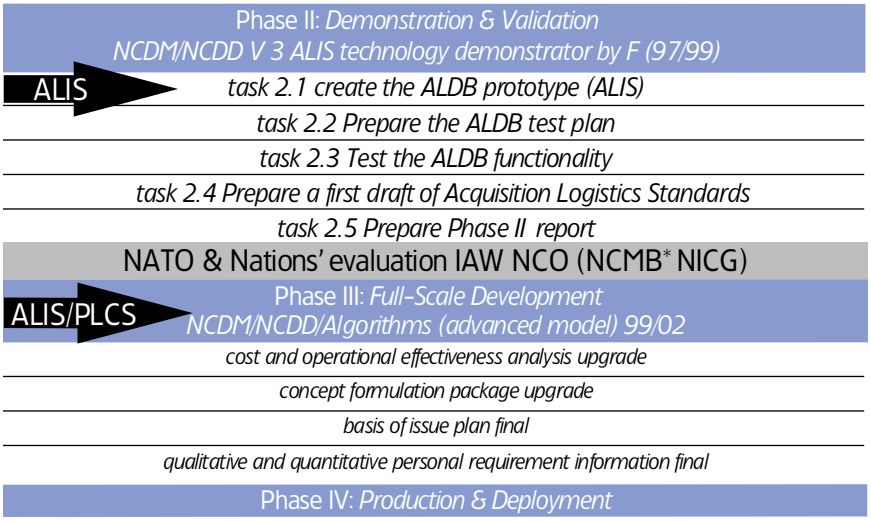
Phase I : *Concept exploration phase & market survey*
NCDM/NCDD V 2 & task 2.2 (94-97) & rig test by GE

prelininary quantitative analysis
GERMANY
(Acquisition Logistics Support)
LIFE CYCLE SUPPORT (core standard = core-model)

concept formulation package (trade-off determination analysis best technique cost & operational effectiveness analysis)

operational & organizational plan

FIGURE 10. **NCPP No. 1 Shared Property**



technical documentation, or TechDoc — the technical information accompanying industrial products and systems to allow end-users to operate and maintain them.

The structure of the ALIS platform is very modular. Software components are available off-the-shelf and have already been replaced since the initial proposal; they will be replaced again as new software tools are offered in the marketplace. Other features include:

- ALIS uses some software from ISS, Inc.
- The user interface is written in Java.
- ALIS platform implementation with the NCDM also demonstrates the maturity of the CALS initiative.

From NCPP No. 1 to Shared Logical Database

The crux of any organization is stability. This is especially true with logistics in view of the seeming inertia across the total spectrum of national defense systems, coupled with the cost involved (Figure 8). A general purpose architecture for interoperability, or high-level architecture (HLA) facilitates the remodeling of logistics from "factory-to-foxhole," i.e., customer-oriented, ensuring high-level consistency for both military and industrial operations, independent of the current technology. Only with the structured stability of HLA can logistics be remodeled to reduce operating costs, encourage joint operations (both for military and industry), and facilitate the diffusion of IT, which provides users the supply item information they need. In the implementation of the STEP approach, the supply chain gives the information neutral fiber; agility comes from the linkage between information and material flows.

NATO CALS Organization Effort

The ALIS technology demonstrator opens the door to NCPP No. 1, Phase III, Industrialization (Figure 8). At this stage, users can get more directly involved in CALS Phase III and derive benefits from IT. It should be easier for Europeans due to the necessity for cooperation and a shared understanding of the holistic approach. The ALIS platform is certainly a contribution to that approach, which comes from IT and requires a continuous process (Figure 9).

NCPP No. 1 Shared Property

The next step should be taken through very strong trans-Atlantic cooperation, including (on the European side at least) the United Kingdom, Germany, Italy, and France. Both defense industry and the military need to be friendly and open so the civil area can converge on the ISO/STEP level (Figure 10).

Let us consider the business context of a multinational program. On the industrial side, a weapon system is likely to be designed and manufactured by one or more prime contractors formed by different companies. These prime contractors operate through an extended chain of subcontractors and suppliers.

On the government side, the national and inter-allied defense systems are likely to be operated by several armed forces of different nationalities. The system may also be deployed as part of a multi-national combined task force to operate anywhere in the world.

As stated at the beginning of this article, large information interchange is required more and more for all activities. In all probability, partners have used very different information systems for a long time, but now they need to establish, update, and exchange digital information in different formats and with different meanings, by using expensive and inefficient interfaces.

Clearly the conversion of information into digital format will improve all busi-

FIGURE 11. **NCPP No. 1 Shared Solution**

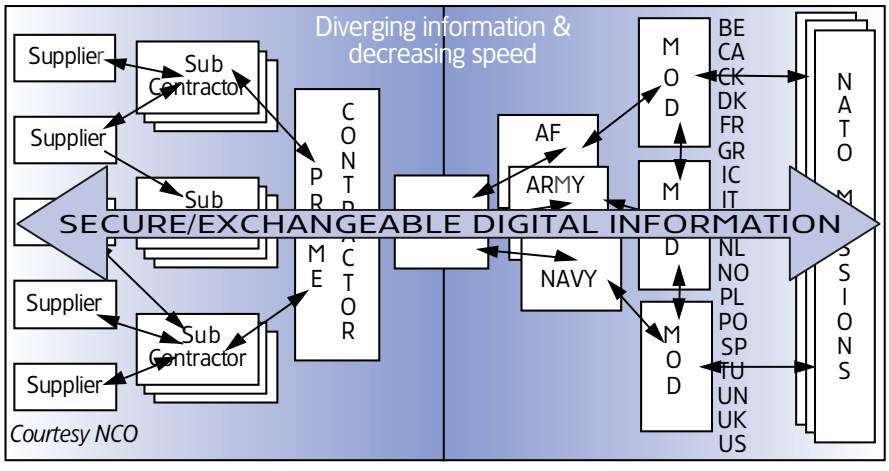
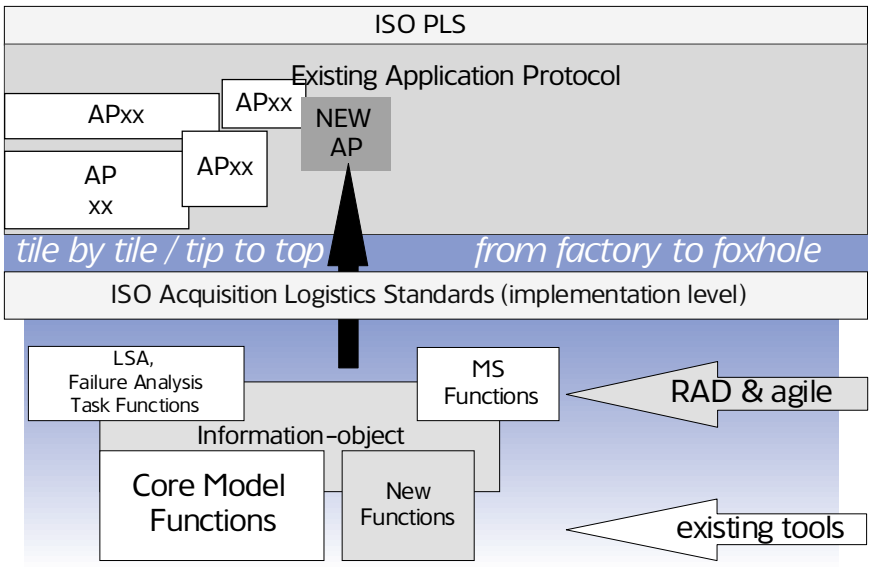


FIGURE 12. **ALIS Start-up — The Product Life Cycle Standards (PLCS)**



ness activities. We need to define secure and exchangeable information during the life cycle of the weapon system (Figure 11).

We must have the capability to circulate data coming from different shared databases of different countries; with the constraint that each country (and each prime contractor) will not have to rebuild its own current systems. Product data are totally covered in real time from both user and producer points of view.

ALIS Supports the Product Life Cycle

ISO 10303 standard (STEP) already facilitates sharing and exchanging product technical information through some application protocols. A Product Data Management (PDM) approach is well suited to logistics activities—provided a data model, a data dictionary, pertinent algorithms, and a logistics application protocol are defined and recognized (Figure 12).

Applying and exploiting the extension of STEP to logistics, industries will be able to produce any system in cooperation. Information will be attached to the shared product and will remain independent from each current and proprietary information system. The capability to supply items and provide information quantity in accordance with the running of the existing and common supply chain will ensure agility.

The higher the speed, the lower the cost, and the better the reliability. The cost to introduce the STEP approach in logistics is low: You only have to pay 30 percent of the software costs once. Due to the relative inefficiency of information systems, engineers working on complex systems currently lose 30 percent of their time looking for the relevant information they need.

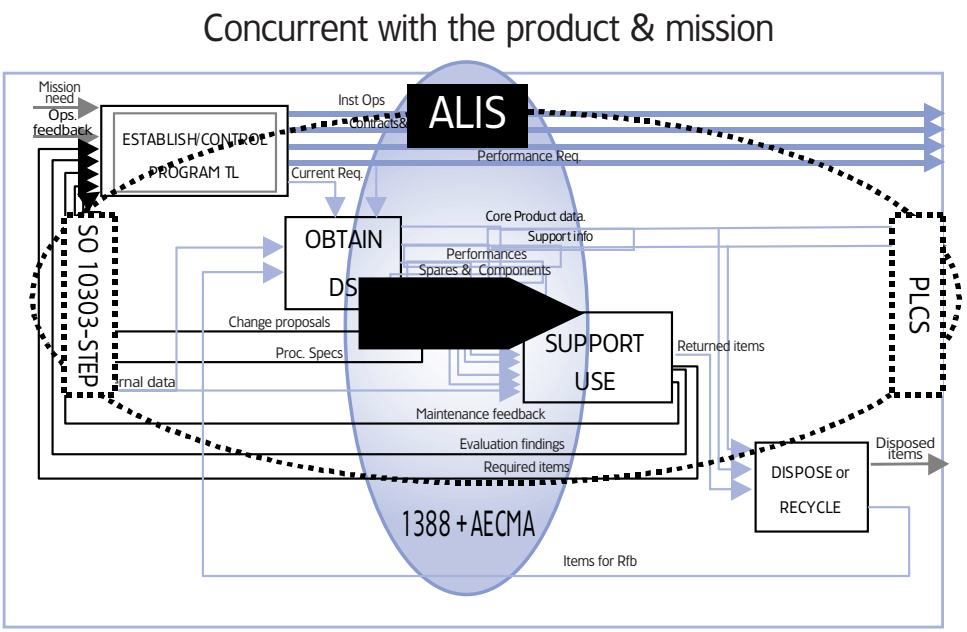
The impact on each skill will be low, because the data dictionary is built from the current standards (MIL-STD 502/MIL-PRF 49506, and AECMA/ATA Spec). Industrial consequences are immediate: It will be possible to quickly share the data of systems under development, whatever current information systems might be. This is a good answer to the political concerns for European and Trans-Atlantic cooperation (Figure 13).

Open and Shared Contributions

A product has to answer the needs for which it is designed (or for the market). Financial availability and industrial capability are the constraints. Therefore, we have to provide the right answers to meet users' logistics needs and support their respective logistics functions, at a cost they can afford. Such support might include any of the following areas:

- Battle damage repair; supply; or logistics maintenance for weapon systems online.
- Complete overhaul; test and inspection; or repair for logistics maintenance of weapon systems in service.

FIGURE 13. **ALIS Supports the Product Life Cycle**



- Restoration; improvement; manufacturing and system engineering for in-manufacturing support.

IDE Logistics Architecture Frame

The commonality of supply chain (spare parts integrated with current production) and a logistics information system (provides information) guarantee speed, low cost, and availability; that means that the higher-level logistics architecture is becoming increasingly common, as an example, between a military organization such as the Tank-automotive Armaments Command (TACOM) and the automotive industry (the necessary changes having been made).

Without entering into any further details, obviously this is a highly complex problem with a wide range of dynamic (e.g., management) and stable (e.g., product) information being established and continuously updated across the 20 or 30 years of the life cycle (Figure 14). The control and management during the life cycle, the in-manufacture support, the in-service support, and finally the disposal are in fact constrained more by the duration of the life cycle than by the military organization.

With ALIS we have only to distribute the effort between the design, logistics support, modeling and simulation, and test and development activities. It is the core of the model that we need; we have now only to deal with in-manufacture support, in-service support, and on-line-support to be able to produce the information flow between partners in different time zones and locations, using all of their own information systems.

And the challenge for the defense industry is to share, as much as possible, the logistics approach with civilian industry: It remains the best way to cut costs. The combat specificity requires agility and reconfiguration capability. This is also a fundamental quality of the best industry practices. Therefore, the NATO CALS effort to consolidate a shared logical database model for life cycle product support is not only now possible—but it is the right time for we and our NATO partners to conduct experiments. Won't you join us in evaluating and supporting the NATO CALS ALIS technology demonstrator?

Editor's Note: Editing and translation assistance was provided by **Greg Caruth** and **Army Lt. Col. Lise M. Gagne**. Caruth is Director of the DSMC Press. Gagne is currently a DSMC professor in the Program Management and Leadership Department. Her former assignment was as the Commander, U.S. Army Research, Development and Standardization Group—France (USARDSG-FR).

ENDNOTES

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Christian Lapaque is the ALIS joint-contractor and contributes to the Logistics Quality Evaluation Book for the European automotive industry. He is working with the United Kingdom CALS International Congress (UK-CIC) Logistics Support Working Group to establish common European logistics practices, and with MRO in the aircraft industry. He was initial product manager of the ISO logistics® program (supply chain support). Retired from the French Army, he served as an officer in a mechanized infantry unit, and on the technical staff of the Army as an antitank combat developer. During Desert Storm, he was the special advisor to the French Headquarters Commander for improvements in online jamming capabilities as well as countermeasures. He graduated from the French War School, specializing in manufacturing, test and evaluation (1978); and architecture, missile, and tank design (1984). (**christian.LAPAQUE@wanadoo.fr**)

Sylvain Noël, has extensive experience in Definition and Design (D&D) and project management, shipbuilding, ordnance engineering, and manufacturing. Within these activities, he applied virtual prototyping CALS principles, particularly for modeling and flexible manufacturing (Tulle). He was the former manager of the French Ministry of Defence (MoD) CALS Office. He is the initiator of the ALIS project and a member of the NCMB/NICG (NATO CALS Management Board/NATO Industry CALS Group). He is a graduate of the French Ecole polytechnique. (**noel@dial.oleane.com**)

FIGURE 14. **IDE Logistics Architecture Frame**